BEST AVAILABLE IMAGES

Defective images within this document are accurate representation of The original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(12) UK Patent Application (19) GB (11) 2 276 948 (13) A

(43) Date of A Publication 12.10.1994

(21) Application No 9407012.5

(22) Date of Filing 08.04.1994

(30) Priority Data
(31) 9307392 (32) 08.04.1993 (33) GB

(71) Applicant(s)
Paul Prince
Unit 7, Carver Road, Astonfields Industrial Estate, STAFFORD, ST16 3HR, United Kingdom

Derek Mellard
Pippins Green Avenue, Kirkhamgate, WAKEFIELD, West Yorkshire, WF2 0RX, United Kingdom

(72) Inventor(s)
Paul Prince
Derek Mellard

(74) Agent and/or Address for Service
Swindell & Pearson
48 Friar Gate, DERBY, DE1 1GY, United Kingdom

(51) INT CL[5]
G01F 23/24

(52) UK CL (Edition M)
G1N NCFC N19B2Q
H1N NJC N669
U1S S1270 S1966 S1967

(56) Documents Cited
GB 2146777 A

(58) Field of Search
UK CL (Edition M) G1N NAEPF NARA NCFC, H1N NJC
INT CL[5] G01F 23/24, H01H 29/00 29/02 29/04

(54) Liquid level sensor

(57) A liquid level sensor (10), especially for the drip tray of a refrigerator has first and second cup shaped members (12, 14) formed from an electrically conducting material and separated by an insulating member (16). Conductors pass through a hole (18) in the insulator (16) to connect the first and second members (12, 14) to a power source which includes current detecting means to sense when the gap between the members is bridged by a conducting fluid. The circuit shown uses a relay 32 to control a pump to remove condensate from the tray and includes a resistor (40) to set the switching level.

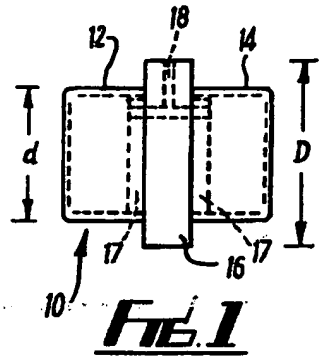

FIG. 1

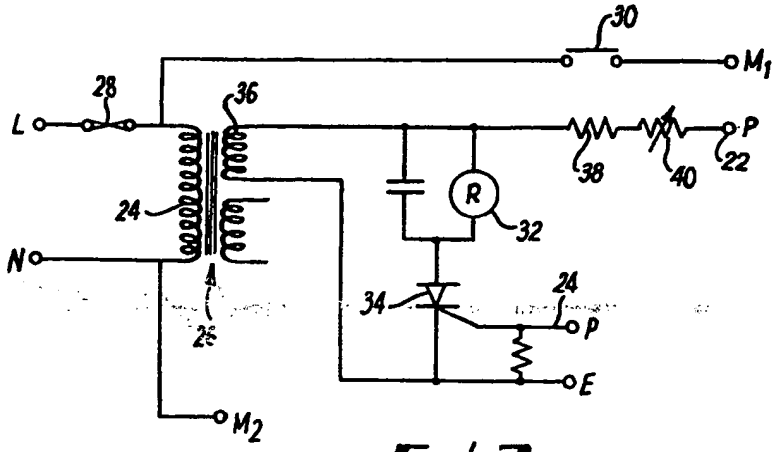

FIG. 3

GB 2 276 948 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

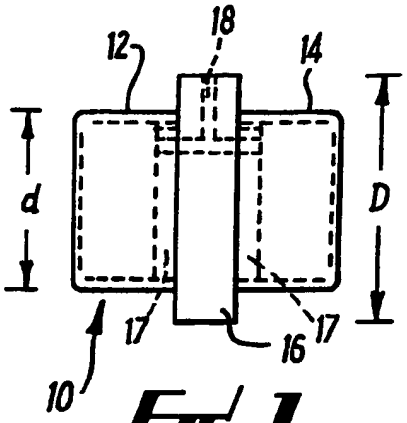

FIG. 1

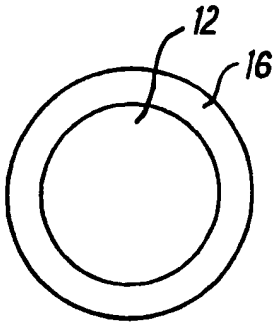

FIG. 2

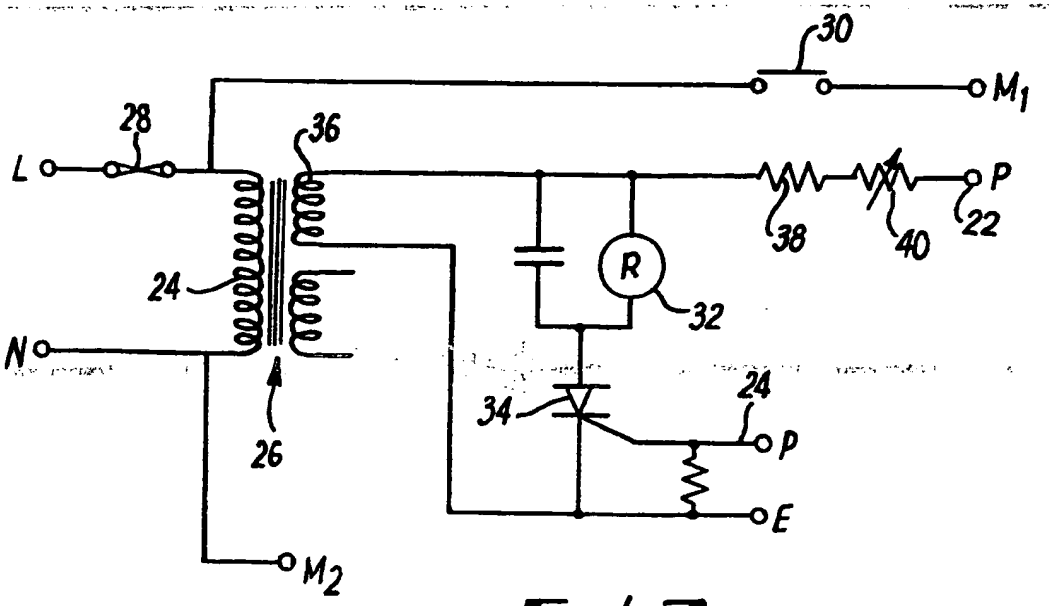

FIG. 3

2276948

Improvements in or relating to Sensing Apparatus

The present invention concerns improvements in or relating to sensing apparatus, especially but not exclusively liquid level sensors.

The invention finds one of its uses in the removal from a condensate drip tray in a refrigeration, or more particularly, an air conditioning plant but it has to be realised that the invention is not restricted to this area of operation. The sensors involved may find use in other areas, detecting the level, presence or absence of any fluent material which conducts electricity to a greater or lesser extent.

The drip trays currently employed in refrigeration or air conditioning apparatus are often provided with a liquid removal line which incorporates a pump, typically a peristaltic pump, which is activated when the condensate within the tray reaches or exceeds a predetermined level.

It has to be realised that the sensing of liquid in drip trays of this nature is not straightforward due to two main factors, the first being that the liquid in the tray has a large proportion of distilled water therein, (pure distilled water having no electrical

conductivity), the second being that the condensate is often badly contaminated with dust, fluff and other debris which can adverseley affect the liquid level sensor. For example, if an inaccurate signal is sent by the sensor then the pump could operate in conditions where no condensate is present so that not only does the pump operate "dry" but also it operates for a much longer time than is necessary, consequently reducing the life of the pump.

It is an object of the present invention to obviate or mitigate these and other disadvantages.

According to the present invention there is provided a liquid level sensor comprising first and second members of an electrically conductive material electrically insulated from each other by an intermediate member of an insulating material, at least one of said first and second members being cup shaped, said first and second members being connected to an electrical power source which includes means operable to provide electrical detection of the bridging of the intermediate member by an electrically conductive fluid.

Preferably both first and second members are cup shaped and have the same dimensions.

Preferably, both first and second members have a circular end plate with two cylindrical skirts depending therefrom. Preferably the intermediate member is disc-like and has stepped protrusions therefrom over which the first and second members can be press fitted. Preferably a passage is provided through the intermediate member for the electrical connectors.

Preferably, the outside diameter of the intermediate member is greater than the outside diameter of the skirts of the first and second members.

Further according to the present invention there is provided a device for sensing the level of condensate in the drip tray of a refrigerating apparatus, comprising a liquid level sensor having first and second cup shaped members of an electrically conducting material separated by a disc-like intermediate insulating member, an electric conductor connected to each of the first and second members and leading to a source of electrical power which incorporates means for detecting and if necessary evaluating the supply of current to said members.

Preferably, the detecting means have variable sensitivity.

Preferably the apparatus includes also a relay so that on detecting a current of a predetermined value the relay is actuated to energise the power supply of a pump in a line leading from the drip tray.

Preferably the pump is a peristaltic pump.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:-

Fig. 1 shows a front elevation of a liquid level sensor;

Fig. 2 shows an end elevation of the sensor; and

Fig. 3 shows a circuit diagram.

A liquid level sensor 10 is intended for use in the drip tray (not shown) of a refrigeration apparatus which, for example, could be a chest for displaying frozen food or the refrigeration plant of an air conditioning apparatus. In each instance, on operation, the refrigeration apparatus produces condensate which is collected in the drip tray. When the condensate has collected to a sufficient depth it is desirable to pump it away from the drip tray and to this end the drip tray

is provided with a discharge line leading to a pump which, in normal circumstances is a peristaltic pump. Clearly, for economy and with a view to giving the pump as long a life as possible, it is desired that the pump operates only when liquid has to Obe discharged from the drip tray.

The sensor 10 of the present invention, as can be seen from Figs. 1 and 2, comprises first and second cup shaped members 12,14 preferably pressed from metal, for example, stainless steel or copper. They are held in facing end to end relationship by a intermediate member 16 of a plastics insulating material, the outside diameter 'D' of which is greater than the outside diameter 'D' of the first and second members. The intermediate member 16 has two protrusions 17 on each side thereof of the outside diameter equal to the inside diameter of the members so that they can be press fitted thereon. A passage 18 is drilled through the intermediate member 16 to accept a twin-core electrical cable (not shown). One of the conductors 20 of electrical cable is connected to the first member 12, the other 22 to the second member 14 and sealant (not shown) is provided around the cable at the passage 18 through the intermediate member to ensure that the interior of the sensor is fluid tight.

The cables lead from the liquid level sensor 10 to the electrical circuit illustrated in Fig. 3. The circuit is used to control and provide power to the pump. Mains power is provided through terminals L,N to the primary winding 24 of a transformer 26, through a fuse 28. The mains supply is also taken to terminals M1,M2 (through a master control switch 30) to provide power to the motor of the pump.

The pump motor is turned on and off by operation of a relay 32 under the control of a silicon-controlled rectifier (SCR) 34, as follows.

A secondary winding 36 of the transformer 26 is connected to earth at E and to a first terminal P through a series resistor 38 and a variable resistor 40. The solenoid of the relay 32 is connected in series with the SCR 34 across the secondary winding 36. The gate of the SCR 34 is connected to a second terminal P. The terminals (22,24) are connected to respective first and second members 12,14 of the sensor described above with reference to Figs. 1 and 2.

The circuit operates as follows. When the terminals L and N are connected to a mains supply and the master switch 30 is closed, the mains supply is connected to the motor of the pump but the pump only

runs when the relay 32 is closed to turn on the pump. However, no current can flow through the winding of relay 32 unless the SCR 34 is turned on. In normal conditions with no condensate bridging the intermediate member 16, no current can flow between the terminal P and the rectifier 34 will remain switched off. As the condensate level rises, the resistance between the members 12,14, and hence the resistance between the terminals P will decrease. Eventually, the water level will rise to a point, set by the variable resistor 40, at which the resistance has dropped sufficiently to cause the gate voltage to turn on the SCR 34. This allows current to be drawn through the solenoid of the relay, thereby turning on the pump. As water is pumped out, the resistance between terminals P (22,24) will increase until eventually, the SCR 34 turns off again.

In operation the sensor illustrated in Figs. 1 and 2 is suspended in a drip tray, normally resting on the bottom thereof. The fact that the intermediate member 16 has a greater external diameter than the first and second members 12,14 means that it is not possible for, for example a metal tray, to electrically bridge the gap between the first and second members. This can only be bridged by condensate in the drip tray and it will be realised that when the condensate provides an electrical path across the circuit illustrated in Fig. 3 will cause

the pump in the discharge line from the drip tray to actuate, thereby removing condensate from the drip tray until the condensate reaches a level whereby it ceases to bridge the insulation between the first and second members at which stage the pump will stop.

The particular design of the liquid level sensor is especially appropriate to drip trays in refrigerating and air conditioning apparatus as it presents a large surface area of conducting material to the relatively low conductivity condensate in the tray while at the same time it cannot readly be bridged by debris in the condensate which could give a false impression of the presence of condensate.

Whereas the description set out above with reference to the drawings refers to the use of the detector in a condensate drip tray it will be readily apparent that the invention is not restricted to such uses. It could, for example, be utilised in a sump, in the bilges of a boat or in any other location where a liquid level has to be detected, the liquid being any liquid or other fluent material capable of conducting electrical current and often being contaminated.

Various modifications can be made without departing from the scope of the invention, for example,

the circular cross-section of the detector described with reference to the drawings could be varied to for example, oval, rectangular or any other suitable cross-section. The ratio of the length to the diameter of the first and second members may be altered. The thickness and diameter of the insulating disc may be chosen to suit any particular circulations. The means for leading electrical connectors to and from the members could be varied in any suitable way and an alternative electrical circuit to activate the pump on dectecting current flow between the member could be employed.

CLAIMS

1. A liquid level sensor comprising first and second members of an electrically conductive material electrically insulated from each other by an intermediate member of an insulating material, at least one of said first and second members being cup shaped, said first and second members being connected to an electrical power source which includes means operable to provide electrical detection of the bridging of the intermediate member by an electrically conductive fluid.

2. A sensor as claimed in Claim 1, in which both first and second members are cup shaped and have the same dimensions.

3. A sensor as claimed in Claim 1 or Claim 2, in which both first and second members have a circular end plate with two cylindrical skirts depending therefrom.

4. A sensor as claimed in Claim 3, in which the intermediate member is disc-like and has stepped protrusions therefrom over which the first and second members can be press fitted.

5. A sensor as claimed in any one of the preceding claims, in which a passage is provided through the intermediate member for the electrical connectors.

6. A sensor as claimed in Claim 4 or Claim 5, in which the outside diameter of the intermediate member is greater than the outside diameter of the skirts of the first and second members.

7. A device for sensing the level of condensate in the drip tray of a refrigerating apparatus, comprising a liquid level sensor having first and second cup shaped members of an electrically conducting material separated by a disc-like intermediate insulating member, an electric conductor connected to each of the first and second members and leading to a source of electrical power which incorporates means for detecting and if necessary evaluating the supply of current to said members.

8. A device as claimed in Claim 7, in which the detecting means have variable sensitivity.

9. A device as claimed in Claim 7 or Claim 8, in which the apparatus includes also a relay so that on detecting a current of a predetermined value the relay is actuated to nergise the power supply of a pump in a

line leading from the drip tray.

10. A device as claimed in any of Claims 7 to 9, in which the pump is a peristaltic pump.

11. A liquid level sensor substantially as hereinbefore described with reference to Fig.1 of the accompanying drawings.

12. A device for sensing the level of condensate in the drip tray of a refrigerating apparatus substantially as hereinbefore described with reference to the accompanying drawings.

13. Any novel subject matter or combination including novel subject matter herein disclosed, whether or not within the scope of or relating to the same invention as any of the preceding claims.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report) -13-

Application number
GB 9407012.5

Relevant Technical Fields

(i) UK Cl (Ed.M) G1N (NAEPF, NARA, NCFC); H1N (NJC)

(ii) Int Cl (Ed.5) G01F 23/24; H01H 29/00, 29/02, 29/04

Search Examiner
M G CLARKE

Date of completion of Search
21 JUNE 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-12

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2146777 A (ENDRESS & HAUSER) Whole document	1, 7

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).